

UNITED PLANTERS' ASSOCIATION OF
SOUTHERN INDIA

SCIENTIFIC DEPARTMENT
(TEA SECTION)

ANNUAL
ADMINISTRATION REPORT

FOR

1951—1952

PRINTED AT
THE DIOCESAN PRESS, MADRAS

1952



NOTE :

Specimens for laboratory examination should be sent by *unregistered* parcel post to

The Officer-in-Charge,
U.P.A.S.I. Tea Experiment Station,
Devarshola P.O.,
Nilgiris.

In the case of specimens too bulky to send by post, they should be sent by rail to Ootacamund and the Rail Receipts or Parcel Way Bills sent to

The Rajalakshmi Motor-Service,
Ootacamund,

for collection and forwarding to Devarshola.

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TEA SECTION COMMITTEE

(Elected August 1951)

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Mr. A. W. Reid	..	..
Mr. K. N. Ananthasivan	..	..
Mr. J. F. Caldwell	..	..
Mr. A. H. J. How	..	..
Mr. S. J. Silas	..	..

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Mr. C. M. Kothari, M.L.A.	..	<i>Planting Member</i>

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Mr. K. N. Ananthasivan	..	<i>Member</i>
Mr. A. W. Reid	..	..
Mr. A. H. J. How	..	..

SCIENTIFIC DEPARTMENT

TECHNICAL STAFF

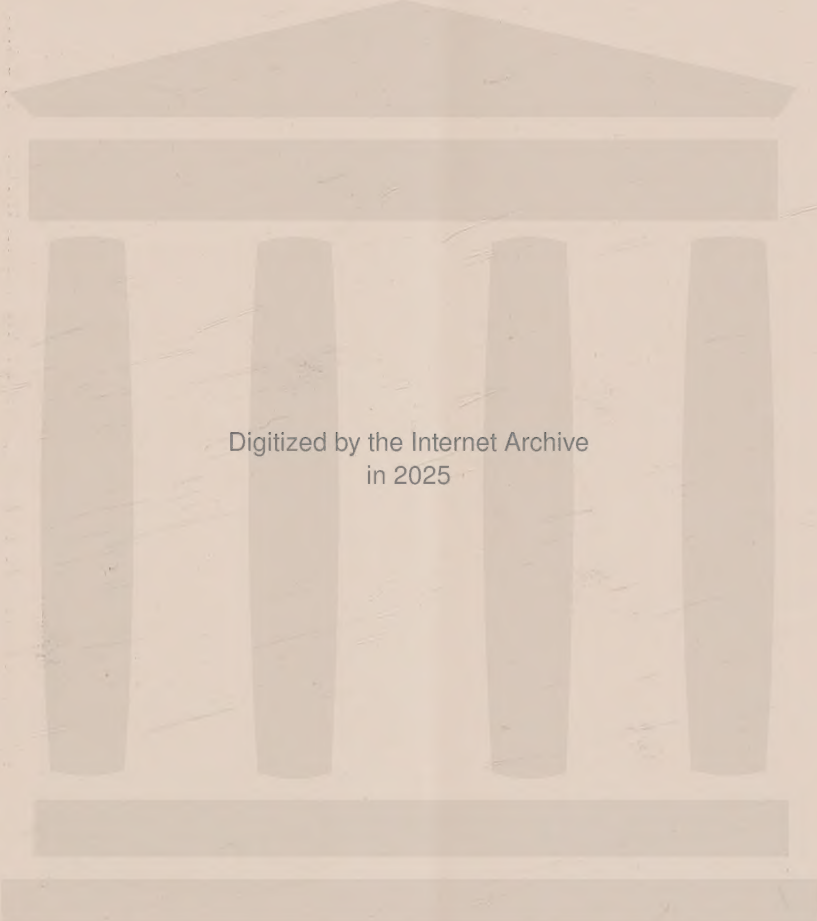
Mr. P. de Jong, B.A. (Hons.) Oxon.	..	<i>Chief Scientific Officer</i>
Mr. S. Ananda Rau, M.Sc.	..	<i>Asst. Scientific Officer and Entomologist</i>
Mr. V. Jayaraman, B.A., B.Sc. (Ag.)	..	<i>Chemist</i>
Dr. K. S. Venkataramani, M.Sc., Ph.D., F.B.S.	..	<i>Botanist</i>

JUNIOR STAFF

Mr. E. P. Powell	..	<i>Field Recorder</i>
Mr. V. Raman, B.Sc.	..	<i>Clerk—Devarshola</i>
Mr. C. S. S. Rao	..	<i>Clerk—Coonoor</i>

LABORATORY ATTENDERS

Mr. Sankaran Nair
Mr. Madhavan Chetty



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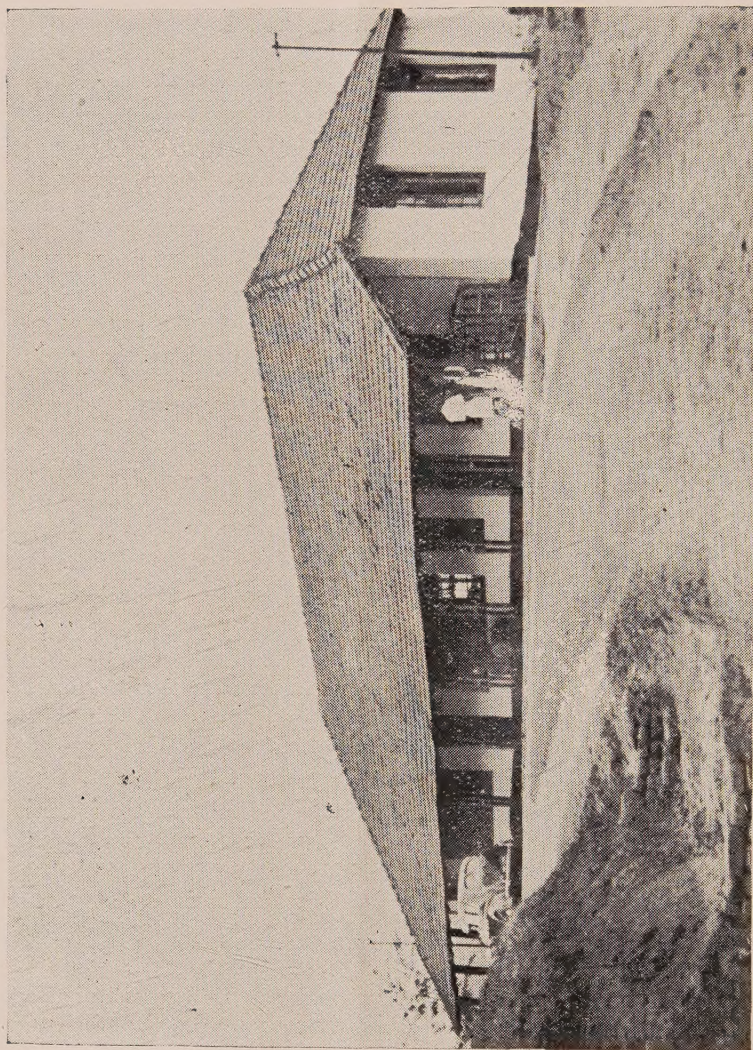


PLATE I—LABORATORY BUILDING, U.P.A.S.I. TEA EXPERIMENT STATION, DEVARSHOLA

UNITED PLANTERS' ASSOCIATION OF SOUTHERN INDIA

ANNUAL REPORT OF THE U.P.A.S.I. SCIENTIFIC DEPARTMENT

TEA SECTION

For 1st April 1951—31st March 1952

REPORT OF THE CHIEF SCIENTIFIC OFFICER

PART I—ADMINISTRATION

Staff and Administration.—The Chief Scientific Officer continued to operate from "Glenview," Coonoor, during the year under review. Mr. D. Raghavan resigned his appointment as clerk to the Chief Scientific Officer with effect from the 31st of March 1951 and Mr. C. S. S. Rao, formerly of the U.P.A.S.I. Labour Department, Mysore, was appointed in his stead with effect from the 12th of April 1951.

There were no changes in the technical staff of the Department and the Asst. Scientific Officer continued to act as Officer-in-Charge, U.P.A.S.I. Experiment Station, Devarshola.

The increase in volume of both administrative and advisory correspondence noted in previous years has continued both in Coonoor and Devarshola. In Coonoor, monthly receipts and despatches averaged about 120 letters each, while at Devarshola, during the period, 877 letters were received and 928 letters despatched.

U.P.A.S.I. Tea Experiment Station, Devarshola.—In May 1951, Mr. A. W. Reid, appointed for the purpose by the Scientific Sub-Committee, visited the Experiment Station. Thereafter no regular visits were made by Mr. Reid but the Scientific Sub-Committee met at the Experiment Station in September 1951.

The Experiment Station area at Devarshola remains the same as in previous years, namely, 13.8 acres planted in tea and 13.2 acres comprising roads, buildings, fuel clearings and swamp areas.

During the year, normal maintenance of laboratory and store buildings, and staff and labour accommodation, was undertaken, including the installation of water-borne sanitation in the Asst. Scientific Officer's bungalow. A certain amount of re-wiring was carried out in the laboratory as a result of the installation of the power line and a service connection is expected to be made during May 1952.

This year illustrates vividly the beneficial effect upon crop of well-distributed rainfall, especially during the critical spring months. The overall rainfall figure was less than the previous decennial average by nearly 12 inches, only 61.59 inches being recorded at the Experiment Station during the period. Nearly 5 inches of rain in April, repeated in May and followed by a very light south-west monsoon, ensured the harvesting of a very heavy crop of green leaf and the crop was maintained at high level throughout most of the year. Though the climate can be credited with much of the increased crop, a great deal of credit must also be given to the increased level of artificial manuring adopted this year. General fertiliser applications to the tea were increased by 20 lbs. of NITROGEN per acre in April

1952, making a 60 : 20 : 20 NPK mixture a general practice in the Experiment Station area. Once again the north-east monsoon proved a failure and the last five months of the year record only 3.93 inches of rain as having fallen on 13 days. Because of the lack of rain in the latter part of the year and on account of the heavy crops harvested, the tea finished with little reserve of vigour and if serious shortages of rain occur in April/May 1952, it is to be expected that the tea will go back to some extent.

In all 66,673 lbs. of green leaf were harvested and sold to our landlords, Messrs. Woodbriar Estates Ltd., at a figure of five annas per lb., realising a sum of Rs. 20,835-5-0. Based on an average outturn of 23 per cent. this quantity of green leaf represents a yield of 1,111 lbs. of made tea per acre. This figure is an increase of nearly 50 per cent. over the made tea per acre figure for 1950/51 and is a graphic illustration of how tea will respond to a rise in fertiliser applications coupled with favourable climatic conditions. The monthly crop figures are given as an Appendix to this Report.

Scientific Sub-Committee.—The Sub-Committee met at “Glenview,” Coonoor, on the 11th December 1951 and on the 25th March 1952. Members of the Sub-Committee, who are all represented on the Research Expansion Sub-Committee, inspected the Experiment Station on the 24th September 1951 when the latter Sub-Committee met at Devarshola.

Research Expansion Sub-Committee.—As a result of the Central Tea Board's proposals to assist tea research in South India, the Tea Product Section Committee authorised the setting up of a Sub-Committee to examine in detail how best such assistance might be achieved and what measure of expansion of the present facilities of the Scientific Department was required. A meeting of the Research Expansion Sub-Committee was convened at Devarshola on 24th/25th September 1951 and certain recommendations regarding the expansion of the Scientific Department were made to the Tea Product Section Committee. These recommendations have formed the basis of discussions with the Central Tea Board and it appears likely that some expansion of the Scientific Department will result.

Publications.—The policy of publishing results of investigations and material of interest to the planting industry in the bi-monthly issues of *The Planters' Chronicle* has been continued, and a list of the notes and articles published by members of the Scientific Department technical staff are included as an Appendix to this Report. In addition, material is being assembled for a separate publication on the types of green manure plants and also on the manuring of tea in South India.

Touring.—During the year, touring and liaison visits were paid to most districts in South India by the members of the Scientific Department technical staff. A list of such tours appears in Appendix III.

In addition to local touring, the Chief Scientific Officer paid a short visit to north-east India early in 1952. The opportunity was taken to visit the Indian Tea Association Scientific Department at Tocklai and to visit tea areas in the Upper Assam Valley and in Darjeeling district.

U.P.A.S.I. Scientific Conference and Exhibition.—Once again “Planters' Week” included an Exhibition and Scientific Conference. The Scientific Department stall at the Exhibition was organised around the central theme of crop protection and contained a number of exhibits of diseases of tea and suggestions for their control.

The Scientific Conference was well attended by all sections of the planting industry and the subject chosen for discussion was “Some Present Day Problems

of Plantation Crops." Papers were presented by the Director of Research, Indian Coffee Board, the Field Officer, Indian Rubber Board, and the U.P.A.S.I. Scientific Department.

Boards and Committees.—The Chief Scientific Officer continued to be the U.P.A.S.I. representative on the Indian Council of Agricultural Research, Crops & Soils Wing, and on the Nilgiris District Soil Conservation Board. Unfortunately, it was not possible to attend the biennial meeting of the Crops and Soils Wing of the I.C.A.R. held at Indore in March 1952, but the quarterly meetings of the Soil Conservation Board were attended.

Visitors.—The growing interest in the work of the U.P.A.S.I. Scientific Department is emphasized by the large number of visitors to the Experiment Station during the year. In addition to the many planters and representatives of industries allied to that of planting who visited the Station during the year, we were pleased to welcome the Hon. S. K. Sinha, Chairman, Central Tea Board, Mr. P. E. Joyce of Shell Chemicals Limited, New York, Mr. S. W. Cheveley, Chairman of the Imperial Chemical Industries' Central Agricultural Control, and Mr. T. Rutter, Director, Brooke Bond Limited, London.

PART II—RESEARCH AND ADVISORY

Much of the work of the Scientific Department is concerned with advisory problems, as is shown by an analysis of the correspondence during the year. At "Glenview," Coonoor, over 250 queries were dealt with, more than half of which concerned the cultivation and manuring of tea. At Devarshola too, much time was spent in dealing with correspondence seeking advice on local problems, and the number of queries dealt with gives some idea of the volume of work handled by the technical staff at the Experiment Station.

1. Botanical and Mycological Section ..	126	Memoranda prepared.
2. Entomological Section ..	69	" "
3. Chemistry Section ..	230	" "
Comprising : Soil Analyses ..	133	
Fertiliser Analyses ..	28	
Copper Estimations ..	52	
Insecticide and Fungi-		
cide Analyses ...	12	
Miscellaneous Analyses	5	

Important as such routine advisory work is, it is also necessary that some form of original investigations are carried out. The Scientific Department of the U.P.A.S.I., as at present organised, is capable only of investigations into *ad hoc* problems of crop production and protection affecting the tea industry in South India. While some of these investigations may properly come within the scope of one section of the Department, it is more usual to find that the problems involve investigations falling within the sphere of interest of two or more sections and a co-ordinated research programme necessitating the co-operation of all members of the technical staff is frequently required. This is particularly so in the case of investigations into the Blister Blight disease of tea (*Exobasidium vexans*, Massee) which are carried out with the help of all members of the Department.

Work of the three sections, Entomology, Chemistry, and Botany and Mycology, will be described in detail in the reports of the respective heads of the sections but it is desirable here to make brief reference to some of the work carried out by the individual sections and the Department as a whole.

ENTOMOLOGY SECTION

The main insect pest of tea in South India remains the Tea Mosquito Bug (*Helopeltis theivora*) confined, fortunately, to parts of Central and South Travancore. Before 1948 this pest did considerable damage to the tea in this area, causing losses of crop to a much greater extent than Blister Blight in the same districts. Since the introduction of DDT treatment as a control measure, this pest is no longer a menace, and the tea in these erstwhile affected areas has improved beyond recognition. Satisfactory as this is, however, it is not right to view the position with complacency. The large-scale use of any insecticide brings in its train a number of subsidiary problems which may remain latent and of potential menace or may manifest themselves as unfortunate consequences of the disturbance of the balance of Nature. The possibility of *Helopeltis* developing a resistance to DDT is not to be discounted as precedents are by no means few and far between. Further, the possibility of the use of DDT aggravating the occurrence of other pests such as the Red Spider Mite (*Paratetranychus bioculatus*) or the Purple Mite (*Eriophyes carinatus*) is worthy of careful consideration. As an insurance against the possible failure of DDT the Scientific Department has been considering a number of alternative insecticides which could be used effectively to control the pest without bringing in their train the unpleasant subsidiary effects already referred to. During 1951, the Asst. Scientific Officer obtained and screened a number of newly-developed insecticides potentially suitable for the control of *Helopeltis* and this work is being continued. A measure of success of DDT in controlling *Helopeltis* is exemplified by the difficulty experienced by the Asst. Scientific Officer in obtaining insects for laboratory trials during his visit to Vandiperiyar at that period of the year when the pest used to be most active in the district.

Reference has already been made to the problem of Mites on tea, especially the Red Spider Mite and the Purple Mite. In the past, Mite attacks have been commonly recorded on tea throughout South India during the dry weather, but in 1951/52 it appeared that infestation was particularly severe on those areas of tea which had been treated with DDT for the control of other insect pests. Though in no case has Red Spider yet assumed the importance that it has in north-east India, it seems possible that it has become more widespread in South India possibly as a result of DDT applications. These observations give impetus to the work of finding alternative insecticides and also efficient and economic acaricides. A number of the latter formulations have recently been received and are in the process of being screened.

MYCOLOGY SECTION

Since the widespread occurrence of the Blister Blight disease of tea in South India in 1947, considerable attention has been given to the problem and work on the field-control aspects of the disease has been given priority by all members of the technical staff. During 1951, the Scientific Department carried out a Pruning and Protection Trial at the Experiment Station and conducted a further screening of a number of fungicides, both sprays and dusts. Attention was also given to the problem of field equipment and a number of pressure-retaining type knapsack sprayers were tested, together with a wide range of nozzles for the low volume application of sprays. A field-scale experiment on the dusting of tea with copper fungicides was laid out on Mount Stuart Estate in the Anamallais with the co-operation of the Bombay Burmah Trading Corporation Limited and at the same time the staff of the Scientific Department were given every facility to study the progress made in the power dusting of tea on the Wentworth and Mayfield Estates of Malayalam Plantations Limited. The assistance of Malayalam Plantations Limited and the Superintendents of their estates in providing such facilities and putting at our disposal all available information regarding the problems and economics of power dusting gained during the 1951 season, together with the

permission to incorporate such information in this Report, is most gratefully acknowledged.

Screening of Fungicides.—Seven dust fungicides, in all cases containing copper as the active principal, and seven fungicidal sprays, of which six were copper compounds and one was a mercury compound, were tested against Blister Blight. The fifteen treatments, each repeated four times on sixteen bush plots, included an untreated series of replicates as a control, and a series of standard Perenox (4 oz. in 10 gallons of water) treatments.

The first fungicidal application was made on the 21st July 1951 and applications were repeated at seven-day intervals until 10th January 1952, after which the disease died down. Throughout the experiment the dusts were applied to the small plots using an Acme Powder Blower at rates equivalent to 10 lbs. of dust per acre and sprays were applied at rates equivalent to 15 gallons per acre using a Leo-Colibri No. 7 pressure-retaining knapsack sprayer fitted with a low volume nozzle.

It was unfortunate from the point of view of the research worker that Blister Blight did not prove to be particularly widespread during 1951, with the exception of a five-week period from early November to mid-December when average leaf infection on the control plots rose to 80 per cent. However, sufficient infection was present to enable the results of the treatments to be assessed with reasonable accuracy and these results are summarised in Table I. As on previous occasions, the method of assessment of infection was based on two series of observations, firstly, subjective examination of the individual plots the day prior to plucking when the degree of bush infection was determined visually, and secondly, by inspecting a proportion of the harvested flush and scoring it appropriately depending on the degree of stem and leaf infection observed.

TABLE I
Percentage Infection of Sprayed and Dusted Plots

		19th July 1951 to 10th Jan. 1952		8th Nov. 1951 to 14th Dec. 1951	
		Bush Infection %	Leaf Infection %	Bush Infection %	Leaf Infection %
Control	..	49.3	44.4	76.6	80.0
<i>Dusts—</i>					
Cuprosana 2% (1)	..	23.8	20.7	34.6	40.6
Perelan 2% (2)	..	27.4	22.7	38.0	40.8
Perelan 4% (2)	..	25.0	23.9	37.2	45.2
I.C.I. 2% Oxychloride (2)	..	31.6	29.2	47.0	56.0
I.C.I. 4% Oxychloride (2)	..	24.7	20.4	37.1	39.8
Bugges 2% Oxychloride (3)	..	30.9	27.7	47.2	50.6
Wetcol 3% (3)	..	22.6	20.4	32.0	37.7
<i>Sprays—</i>					
Perenox 4 oz./10 galls.(2)	..	17.5	14.2	27.0	25.4
Yellow Cuprocide 2½ oz./10 galls. (4)	..	22.0	18.0	34.6	37.8
Yellow Cuprocide 1½ oz./10 galls. (4)	..	24.8	22.7	39.8	47.8
Fungex 1 in 25 (5)	..	15.5	10.1	24.2	19.7
Mercury Fungicide 1 in 128 (5)	..	15.7	11.4	20.4	19.2
Bordeaux Mixture 2-2-40	..	21.5	16.5	32.4	35.7
Parry's Bordeaux Mix. 2-2-40 (6)	..	19.0	16.9	30.4	34.2
Significant Difference 5%	..	8.02	8.48	11.23	14.2
1%	..	10.55	11.18	14.8	18.7

(1) Universal Crop Protection Ltd. (2) Imperial Chemical Industries (India) Ltd.
(3) Bugges Insecticides Ltd. through Aspinwall & Co. Ltd. (4) Amritlal & Co. Ltd.
(5) Murphy Chemical Company Ltd. (6) Parry & Company Ltd.

In general, the dusts appeared to be less efficient than the sprays, though only in a few cases are there any significant differences between the treatments in the two classes of fungicides. The specially formulated Copper Oxychloride 2% Cu dust, supplied by Imperial Chemical Industries (India) Ltd., did not compare in efficiency with either Cuprosana 2% or Perelan 2%, though a degree of control of the disease was achieved.

If the figures in Table I, Column 4, are examined, a number of features may be observed. The mercury fungicide has proved to be a little superior to the copper fungicide and this superiority is to be further investigated during 1952, as it seems there might be advantages in using mercury fungicides in tea nurseries where the risk of plant damage by copper presents a considerable problem. The lower concentration of Yellow Cuprocide equivalent to a solution of 2 oz. in 10 gallons of a 50% copper spray, has proved less efficient than might have been expected, as have the two Bordeaux mixtures. There would appear to be no difference between the standard Bordeaux mixture (2 : 2 : 40) and that made with a Copper-Zinc-Nickel-Sulphate supplied by Parry & Co., Ltd., Madras. In both the cases, the Bordeaux mixture gave effective protection, though significantly less than that given by either mercury fungicide or Fungex. In all cases of dusts and sprays, however, a highly significant degree of protection against the disease has been conferred by the treatments.

During the course of this experiment, we were able to examine the problem of toxic hazard arising from the use of mercury on tea in plucking. Samples of oven-dried green leaf from the mercury sprayed plots and from the untreated control plots were sent to the United Kingdom for analysis in co-operation with the Murphy Chemical Company Ltd. The samples of leaf after both 8 and 23 rounds of spraying disclosed the presence of no mercury either by normal quantitative analysis accurate to the order of 0.5 p.p.m. or by spectographic analysis which is considerably more sensitive.

Pruning & Protection Trial.—This trial was laid out in the Experiment Station area and was designed to investigate the relative values of copper-containing sprays and dusts in protecting tea recovering from pruning from attack by Blister Blight.

An area of tea was pruned during the week 18-23rd June 1951 and divided into 12 plots, in 2 blocks of 6 plots. The treatments were :—

1. Control, untreated.
2. Perenox, 2 oz. in 10 gallons, at 17 gallons per acre.
3. Perenox, 4 oz. in 10 gallons, at 17 gallons per acre.
4. Cuprosana 2% dust, at 10-15 lbs. per acre.
5. Cuprosana 6% dust, at 10-15 lbs. per acre.
6. Perelan 4% dust, at 10-15 lbs. per acre.

The first application of fungicides was made on the 18th July 1951 and observations commenced on the 8th August 1951. The period of the trial can be divided into three phases from the point of view of disease attack ; a period of build-up of infection from the 8th August to the 3rd October, a period of decline from the 10-24th October, and a period of build-up and heavy infection from the 31st October to early January 1952, after which the disease died out with the onset of dry weather. Bush infection figures for this period based on visual examination of the plots at regular intervals and representing the mean figures for the two blocks, are given in Table II. The design of the experiment does not permit of the figures being examined statistically and no great weight should be

placed on the differences between treatments, but the figures do show that a very fair degree of protection was given by the spray application of the higher concentration of Perenox and the dry dusting with Cuprosana 6% dust.

TABLE II
Mean Percentage of Bush Infection

TREATMENT	Phase I 8 Aug-3 Oct.	Phase II 10-24 Oct.	Phase III 31 Oct-2 Jan.
Control	65	20	58.2
Perenox, 2 oz./10 galls.	56.3	21.4	41.2
Perenox, 4 oz./10 galls.	21.2	8.8	16.1
Cuprosana 2%	38	17.9	25.2
Cuprosana 6%	18.5	5.5	14.2
Perelan 4%	28.9	13.3	29.5

These conclusions are confirmed by the examination of the leaf infection figures for the two blocks taken during the period 5th September 1951-9th January 1952. The figures given in Table III show the percentage of infection for the whole period and also for the peak infection period from 13th November to 18th December 1951.

TABLE III
Mean Percentage of Leaf Infection

TREATMENT	Period 5 Sep. 51-9 Jan. 52	Period 13 Nov.-18 Dec.
Control	58	80.6
Perenox, 2 oz./10 galls.	35.8	45.5
Perenox, 4 oz./10 galls.	21.0	29.7
Cuprosana 2%	33.6	45.8
Cuprosana 6%	25.4	33.0
Perelan 4%	31.8	38.6

A point which emerged from the trial was that although the sprayed plots appeared to be freer from disease than the dusted plots, when the bushes were tipped a much greater degree of infection was found inside the bushes on the sprayed plots than on the dusted ones.

Power Dusting of Tea.—In 1951, the Scientific Department organised a field-scale power dusting experiment on tea in plucking to study the problems involved in the large-scale application of copper fungicides in dust form. Two fields on Mount Stuart Estate in the Anamallais, totalling 69 acres, were selected for the experiment. Perelan 4% copper dust, specially formulated by Imperial Chemical Industries (India) Ltd., was used for the trial, and the dust was applied with the "Whirlwind" Power Duster assisted by two "New Armada" hand dusters. The area presented many difficulties of climate and topography and it proved difficult to dust more than about 15 acres an hour, excluding quite a high proportion of dead time. At this rate of application, power dusting would definitely appear to be a very expensive proposition as the saving in labour compared with wet spraying is negligible. Difficulty was experienced too with the dust

which tended to clog because of the humidity, and distribution, therefore, was uneven. While little information of value was gained from the trial, the main lessons learnt were that a high degree of organisation and supervision are required if power dusting is to be a practical and economic proposition.

Malayalam Plantations Ltd., Mayfield Estate, adjacent to the Experiment Station, undertook a large programme of power dusting with the Universal Crop Protection Ltd. "Whirlwind" machine using 2% Cuprosana dust. 356 acres of tea, which included 276 acres of first-year fields, were treated with dust at an average rate of 10 lbs. per acre per round. Plucking rounds throughout the period averaged 8-9 days and the number of whole and part rounds of dusting varied between 18 and 26, with the exception of one field where dusting was stopped in the middle of the season.

Throughout the season 6,372 acres were dusted and a total of 62,502 lbs. of 2% Cuprosana dust were applied, the average running cost working out at Rs. 5.282 per acre per round. The final breakdown of this figure is of considerable interest as it demonstrates how low labour and maintenance costs are in relation to costs of the material :—

Cost of material	..	Rs. 4.9
Cost of labour	..	Rs. 0.31
Maintenance of equipment	..	Rs. 0.01
Lorry running costs	..	Rs. 0.03
Petrol and oil for "Whirlwind"	..	Rs. 0.03

The figure of Rs. 5.282 does not include the cost of staff supervision which works out at Rs. 0.083 per acre per round, nor does it take into account depreciation of the power duster. These cost figures agree remarkably with those obtained on Malayalam Plantations Ltd. Pattumallay Estate in Central Travancore where 257 acres of first and second year fields in plucking were dusted with 2% Cuprosana dust at an average rate of 10 lbs. per acre using a Drake & Fletcher "Dustejecta" and four "New Armada" rotary hand dusters. In this case the 7 rounds of dusting for which figures are available show an average cost of Rs. 5 per acre of which Rs. 4.66 represents costs of materials and Rs. 0.34 represents cost of labour, maintenance, oil and petrol, etc.

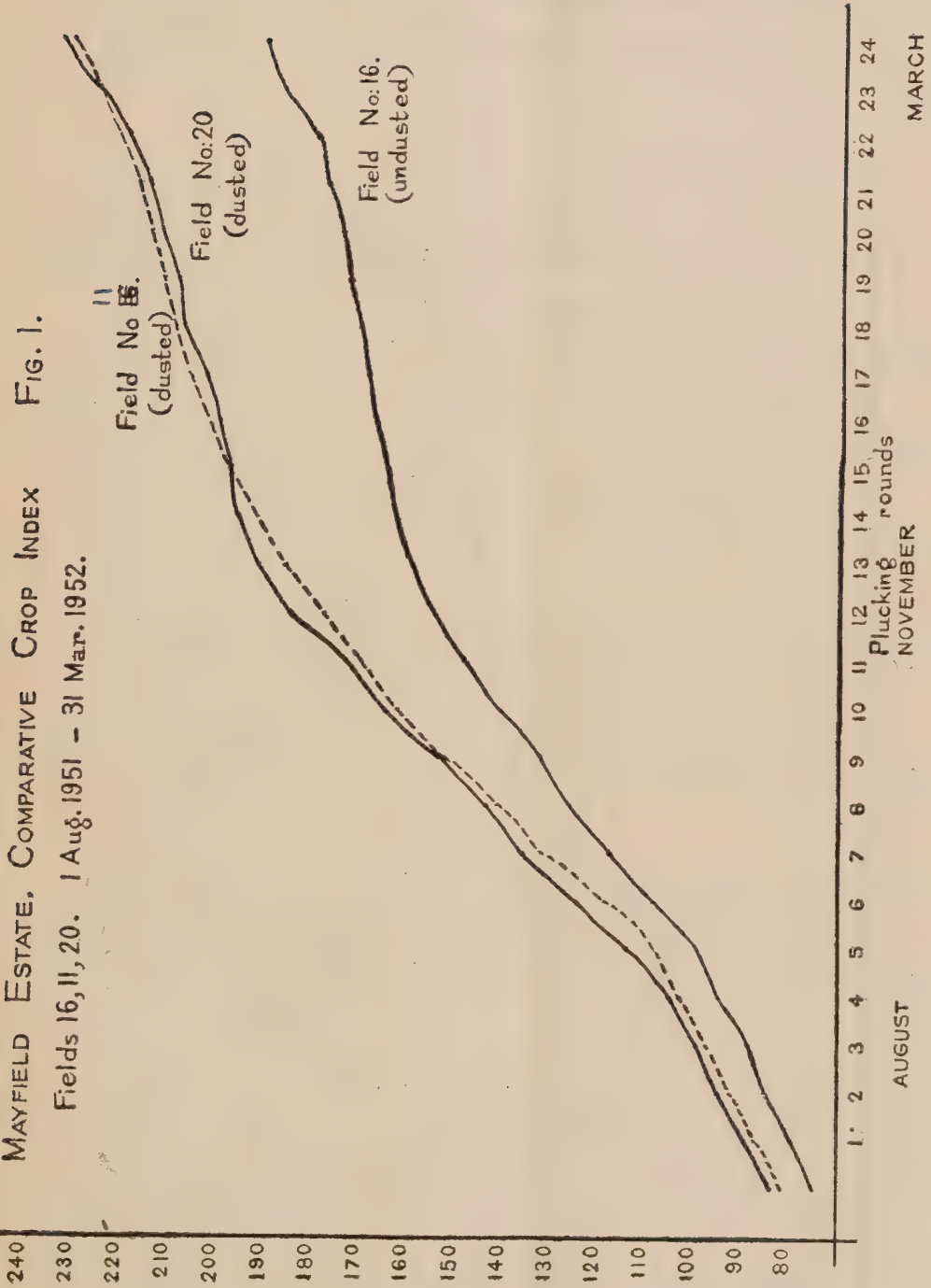
The Mayfield trial provided the opportunity of assessing the protective efficiency of the power dusting treatment. On the estate there are three fields, Nos. 11, 16 and 20 which are closely comparable regarding date of planting, type of planting material, topography, age from pruning, and yield. The average yields in terms of made tea per acre from these fields for the 12-year period 1939-51 and the post-Blister Blight period 1946-51 indicate the relatively equal cropping capacities of these fields, field No. 20 being slightly ahead in yield per acre.

	<i>Field No. 16</i>	<i>Field No. 11</i>	<i>Field No. 20.</i>
1939-51	.. 703	749	770 lbs./acre
1946-51	.. 623	625	745 " "

When dusting commenced on Mayfield Estate in July 1951, field No. 16 was among those fields not receiving treatment while fields 11 and 20 were being included in the dusting programme. From the beginning of the Company's year in April 1951 until the end of July, yields of the respective fields in pounds of green leaf per acre were :—

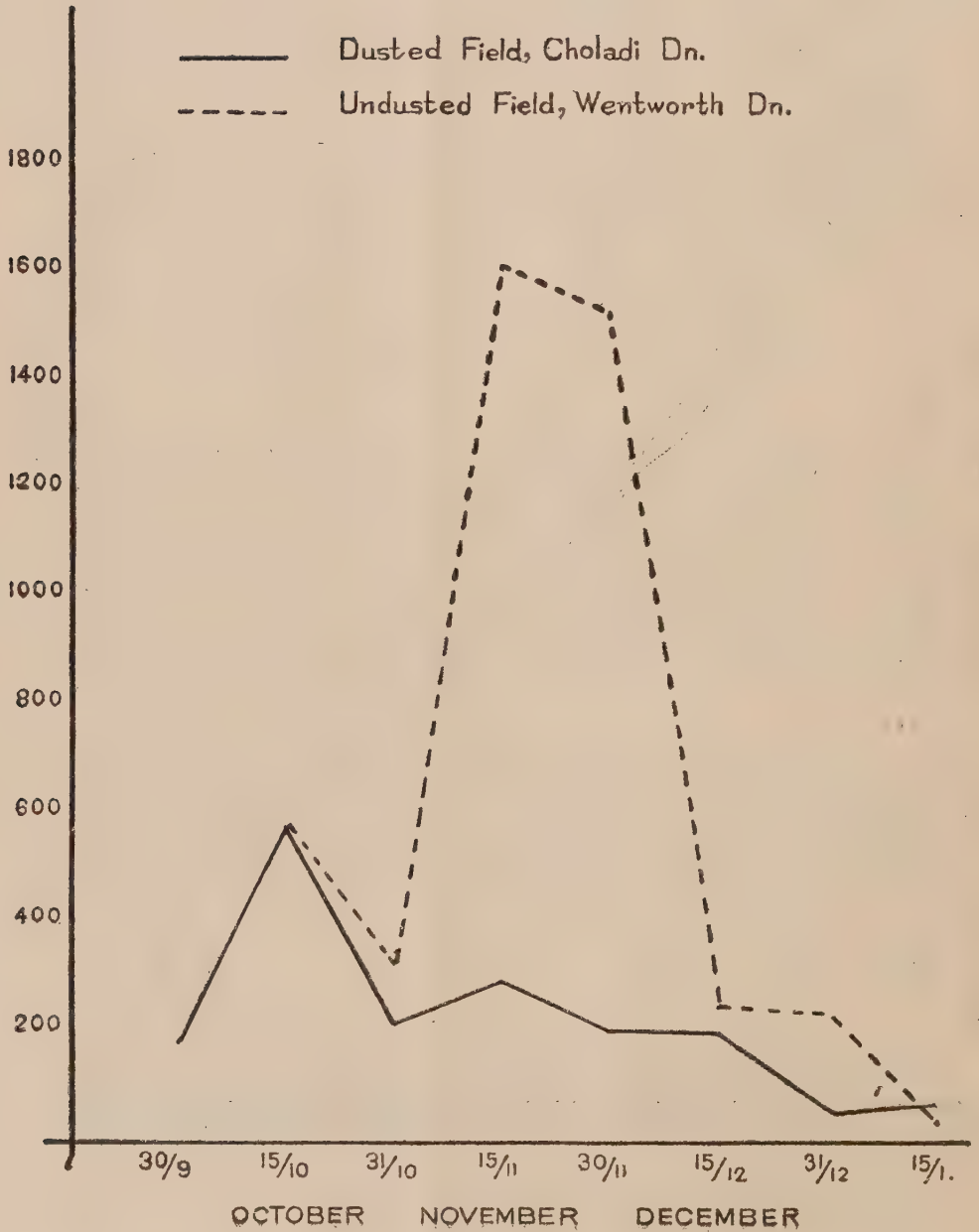
<i>Field No. 16.</i>	<i>Field No. 11.</i>	<i>Field No. 20.</i>
1,505	1,633	1,690 lbs./acre.

MAYFIELD ESTATE. COMPARATIVE CROP INDEX
 Fields 16, 11, 20. 1 Aug. 1951 - 31 Mar. 1952.



WENTWORTH ESTATE.

COMPARATIVE INFECTION COUNTS. FIG. 2.



In the following six months (August 1951—January 1952) during which Blister Blight was active and dusting was in operation, the yields of green leaf per acre on these fields were :—

Field No. 16	Field No. 11.	Field No. 20.
1,997	2,577	2,546 lbs./acre.

From these figures it is apparent that during the period of Blister Blight attack the two dusted fields gained considerably in crop over the undusted field. Records of the individual crops of green leaf per acre from the three fields for 24 individual plucking rounds from August 1951 to March 1952 were maintained and these figures, reduced to a common index, demonstrate convincingly the beneficial effect of dusting upon crop in this case (Fig. 1).

Wentworth Estate provides further evidence of the efficiency of copper dusting in the control of Blister Blight. For various reasons it was not found possible to compare the yields of treated and untreated fields but a series of records were maintained showing the percentage of Blister Blight infection on two comparable fields, one untreated and the other treated with Cuprosana 2% dust at a rate of 10 lbs. per acre for each 11–12-day round. The observations made consisted of examination of a standard number of harvested shoots taken from the same bushes at each plucking round and the figures represent a flush infection index. These figures for the period 30th September 1951 to 15th January 1952 are shown in the form of a graph (Fig. 2).

From the information gained in these and other trials during the course of this year, it appears that prophylactic dusting with a copper dust is a practical and economic proposition, if carried out with a high degree of organisation and supervision. Under the conditions of Blister Blight attack obtaining in South India in 1951, which were not unduly severe until the north-east monsoon period, 2% Cuprosana dust applied at regular intervals of 7–10 days, depending upon the length of the plucking round and at an approximate rate of 10 lbs. of dust per acre, gave adequate protection to tea in plucking and the beneficial effects were to be noted not only in the increased crop but in the more vigorous appearance of the tea at the end of Blister Blight season.

There is reason to believe, however, that in cases of severe disease attack and in certain areas where the topography renders the tea susceptible to prolonged attacks of the disease, a 2% copper dust is inadequate and a 4% copper dust will be required to give adequate protection. Whether in this case the rate of application may be materially reduced is a matter for speculation and further investigation, but it is our opinion that efficient coverage cannot at present be obtained with power equipment at rates less than 7 lbs. of dust per acre.

‘Red Rust’ of Tea.—Another matter of importance in the Mycology Section during the period was the discovery of the widespread presence of ‘Red Rust’ (*Cephaleuros parasiticus*) on tea in Central Travancore. Reports and specimens from Vandiperiyar prompted a local investigation and Dr. Venkataramani visited the district in the autumn of 1951. As a result of this visit, it became obvious that the disease was widespread in the area and a further visit was planned for the period April/May 1952 when it was estimated the disease would be most active and the extent of the problem could be properly assessed.

The presence of a root disease, not previously reported in South India, caused by a fungus of the genus *Cylindrocladium* was also noted on tea in Central Travancore.

BOTANY SECTION

A number of clonal plants of different parent material were received from the Indian Tea Association Scientific Department at Tocklai, Assam, and distributed throughout South India. These plants survived their journey remarkably well and most of them are now well established in their new environments where their progress is being watched.

Some attention has been paid to the problem of the control of grass weeds in tea and a number of potentially useful herbicides have been received for screening. In a preliminary trial carried out at the Tea Experiment Station, 90% Sodium-T.C.A. at the rate of 50 lbs. in 100 gallons of water per acre and AROMEX at the rate of 30 gallons per acre, appeared to give reasonable kill of annual grasses in the tea without having any harmful effect upon the tea itself. Other substances tried were Pentachlor-phenol and Isopropyl-phenyl-carbamate (I.P.C.). More attention is to be paid to this problem in future as it is considered that the chemical control of grass weeds in tea recovering from pruning and in new clearings would represent a considerable saving to the industry.

Arising from work on seed dressings for the control of fungus diseases of tea seed carried out in 1950, a further trial was made in Coonoor in 1951 in which 10 varieties of tea seed were treated with mercury and organic types of seed dressings in order to observe the effects of the treatments on the rate of germination of the seed. The results of the trial are fully reported elsewhere (*The Planters' Chronicle*, Vol. XLVII, No. 7, 1 April 1952) but may be summarised here.

Seed treated with TILLEX, a mercury preparation of Sandoz Products, Ltd., and FERNASAN, a T.M.T.D. preparation from Imperial Chemical Industries (India) Ltd., germinated much more rapidly than the untreated seed. In the case of seed treated with AGROSAN-GN, a mercury preparation from Imperial Chemical Industries (India) Ltd., the effects were not so marked, though in the early stages of the trial treated seed germinated more rapidly than the untreated seed.

CHEMISTRY SECTION

This section is at present responsible for the design and layout of all fertiliser experiments on tea and the maintenance and interpretation of the records of such experiments. During the year, a number of new fertiliser experiments were laid down and these, together with the record of progress of the already established experiments, are referred to in the Soil Chemist's report.

In addition to the normal work of the section, an extra burden was imposed this year when a large number of analyses of dried tea leaf for copper were called for. The section was equipped with a Lumetron Photo-electric Colorimeter and during the latter part of the year, 52 sets of copper estimations were made, involving at times three or four repeat estimations. Many of these analyses were made to ensure that the copper content of teas dusted or sprayed with copper fungicides in the control of Blister Blight did not exceed the statutory tolerance limit of 150 p.p.m. of copper laid down by the U.K. authorities.

ACKNOWLEDGMENTS

Once more it gives me considerable pleasure to record my appreciation of the assistance and co-operation received from all sections of the planting industry in South India, especially the Secretary and Staff of the U.P.A.S.I. Office in

Coonoor, the Members of the Tea Product Section Committee, the Scientific Sub-Committee and the Research Expansion Sub-Committee.

On behalf of my colleagues and myself, I should like to acknowledge with gratitude the assistance of the Director and Staff of the Tea Research Institute of Ceylon and the Chief Scientific Officer and Staff of the Indian Tea Association Scientific Department, Tocklai, and the other Institutions who have helped us from time to time during the year.

Again, we are indebted to a number of commercial interests for the preparation and supply of a variety of plant protection formulations and equipment and for the supply of fertiliser mixtures for certain plant nutrition experiments.

In conclusion, I should like to acknowledge with much gratitude the co-operation of the Agents and Managers of estates in the conduct of field experiments and especially those who have opened their doors to members of the staff of the Department and showed us such hospitality during the past year.

I should also like to acknowledge the willing and untiring co-operation of all members of the Scientific Department Staff which has contributed in no small way to the easy running of the Department during the year.

PETER de JONG
Chief Scientific Officer.

REPORT OF THE ASST. SCIENTIFIC OFFICER AND ENTOMOLOGIST (1951-52)

Administration.—The Asst. Scientific Officer continued to be in charge of the Devarshola Tea Experiment Station throughout the year.

As in the previous year, the work of the Station was directed and supervised by the Chief Scientific Officer who made periodic visits to the Station.

Correspondence.—The volume of correspondence handled at the Station showed an increase over that of the previous year, the figures of letters received and despatched being 877 and 928 respectively. These included 344 technical enquiries received and dealt with at the Station.

Touring.—The details of the touring done during the year are given in Appendix III. The visits made to estates were both in connection with research programme and for advisory purposes. The tour of the Wynaad was of a liaison nature at the conclusion of which the Wynaad Planters' Association meeting was addressed.

ENTOMOLOGICAL

Helopeltis.—DDT dusting which has become routine practice in Central and South Travancore has continued to give satisfactory results in the control of this pest. The simplicity of the operation and the degree of control achieved are liable to give rise to a feeling of complacency of which signs are beginning to be noticed but which should strongly be resisted. A few cases were reported where it was complained that dusting did not produce the same good results as before, but an investigation into the matter revealed that either the mixing of the dust or the manner of application was at fault. The necessity, therefore, for proper supervision over mixing and application cannot be too strongly emphasised.

In view of the difficulty and delay in obtaining supplies of good quality China clay and also perhaps for reasons of economy, inferior grades of China clay of rather coarse texture are often accepted and used. Satisfactory mixtures with DDT can never be made with coarse China clay and the results from the use of such dust mixtures cannot but be disappointing. For satisfactory results, China clay should be of the finest particle size.

The use of Safaga phosphate, which is available in finely powdered form, as a substitute for China clay, is being considered in some quarters. Its suitability for this purpose remains to be tested.

The possibility of *Helopeltis* acquiring resistance to DDT has been kept in the forefront, but observations to date have not revealed any evidence to suspect the failure of DDT to control the pest. Nevertheless, a few new formulations of insecticides, alternative to DDT, were screened preliminarily during October 1951. These formulations were:

- | | |
|--|-----------|
| 1. Derris (Stafford Allen & Sons Ltd.) | .. Dust. |
| 2. Derris (Boots Pure Drug Co. (India) Ltd.) | .. Dust. |
| 3. Derriphytan (Sandoz Ltd.) | .. Spray. |
| 4. Pyrocolloid (Bombay Chemicals Ltd.) | .. Spray. |
| 5. Allethrin (Getz Bros. & Co.) | .. Spray. |
| 6. Pyresyn (S. B. Penick & Co.) | .. Spray. |

In view of the paucity of insects, tests could be made with only a small number of insects at a time. Derris-based insecticides, although found to be toxic to the insect, were generally slow in their action and a small field test carried out with Derris dust (Boots) indicated that it had no residual effect for even a few days after application. It seems unlikely that Derris dusts will compare favourably with DDT either in efficiency or in economics of treatment.

Pyrocolloid, a pyrethrum product, was found to be extremely toxic to the insect and the kills obtained with various strengths were almost instantaneous. Even as low a concentration as 1 in 2,000 was effective.

Tests with Allethrin and Pyresyn, two formulations of similar nature whose active constituent is a synthetic pyrethrin, were rather inconclusive owing to the difficulty experienced in making emulsions suitable for spraying. The required information from the suppliers could not be obtained in time to complete the tests. These formulations together with a few others will be tried out during the coming year.

As regards equipment for dusting, use of power dusters has been given up, perhaps rightly, as the pest position has rendered repeated treatment of large areas unnecessary. Hand dusters are in vogue and several estates employ no dusting machines at all, but use only bags of hessian from which the dust is shaken over the bushes. Although satisfactory results are claimed, hessian bags cannot be expected to produce a thin cloud of dust sufficient to cover the bush uniformly. Further, constant shaking may tend to cause separation in the dust mixture, however thoroughly the DDT and China clay may have been originally mixed. Dusting with hessian bags will not therefore be efficient and may prove wasteful in the long run.

It has become the practice on many estates to dust individual bushes when signs of attack are spotted by pluckers during their plucking rounds. For this purpose, the "Acme" powder blower should prove to be an efficient and handy tool.

Red Spider and other Mites.—Damage to tea by mites was prominent during the dry weather months of the year, reports having been received from Central Travancore, Anamallais, Wynaad, Nilgiris and Nilgiri-Wynaad. Red Spider (*Paratetranychus bioculatus*) and Purple Mite (*Eriophyes carinatus*) were the predominant species, the latter particularly in the Nilgiris, while Scarlet Mite (*Tenuipalpus obavatus*) was occasionally met with in association with Purple Mite.

The occurrence of Red Spider in Central Travancore was reported to be particularly widespread during the year under report but evidence is still insufficient to warrant the assumption that DDT dusting undertaken throughout the district against *Helopeltis* has definitely increased Red Spider. The fact that similar, though perhaps smaller, increases have taken place in other districts, where no DDT is used on a large scale, argues against this assumption. It is probable, however, that DDT dusting is responsible for some measure of the increase of Red Spider and the situation is one which requires to be carefully watched in future years.

A few acaricides effective against this class of pests are already known, but one which does not contain sulphur will be an obvious advantage for use in tea in plucking, in view of the risk of taint which sulphur imparts to made tea. It is

hoped to carry out tests with a few new acaricide formulations during the coming year.

Eelworm.—This pest (*Heterodera marioni*) continues to be a problem in the selection of suitable sites for tea nurseries and a very large number of soil samples and weed specimens from prospective nursery sites were examined during the year in connection with advisory work.

An eelworm survey was undertaken on a group of estates in Nilgiri-Wynaad when it became evident that, except in land under primary jungle, eelworm was ubiquitous in all areas. This circumstance severely restricts the choice of suitable sites for raising nurseries and the only remedy appears to be to select a site satisfactory in all other respects and treat it with a soil fumigant against eelworm, before the nursery is laid down. Shell-DD and Dowfume are two of the soil fumigants which are reported to be effective against root-knot eelworm.

Basket nurseries do not present the same difficulty as bed nurseries. Heat treatment of the soil before filling in the baskets, which is in practice for some years, has been giving very satisfactory results in the control of eelworm.

Widespread attack of the root-knot eelworm on mature tea was discovered for the first time on an estate in Nilgiri-Wynaad. In general, although dadaps in tea areas are often found severely infested and their roots lie in close contact with those of tea, the latter are never attacked. In view of this experience, the attack observed is of some significance. The implications of this attack are, however, not fully understood, but it seems almost certain that the thinness of bushes and their markedly delayed recovery from pruning are due to eelworm attack which appears also to be the reason for failure to establish dadaps in fields found to be infested.

Root-knot eelworm is reported on mature tea bushes in Ceylon, though only very rarely, in a few areas at high elevation. There are no reports of its occurrence on mature tea at elevations comparable to that of the estate in South India on which it has now been found.

Although expert opinion is inclined to consider the eelworm in mature tea as belonging to the same species as that found in tea seedlings and *Tephrosia*, Dr. Gadd, formerly of the Tea Research Institute of Ceylon, believed that there must be two races of this species, the one infesting mature tea bushes being a newly evolved race (*Monographs on Tea Production in Ceylon* No. 2, p. 81). Should this belief be found to have basis in fact, there is risk of progressive invasion of adult tea in course of time, but again, according to Dr. Gadd (*ibid*), evidence to date does not lend much support to this view.

As regards control, there is unfortunately no direct method of a practical nature that can be recommended. Soil fumigants cannot safely be used in standing tea. Recourse should, therefore, be had to increasing the organic matter status of the soil, as this is believed to reduce the worm population in the soil presumably by encouraging predatory nematodes, and thus help to mitigate damage to tea roots. Such a measure would, at the same time, assist the bushes to grow ahead of eelworm attack.

Improvement of soil organic matter is best achieved by growing a green manure crop such as *Crotalaria anagyroides*, *in situ* and digging it in. *Tephrosia* species should be avoided as they are highly susceptible to root-knot eelworm and there is risk of increasing the worm population by growing them.

Pests of *Crotalaria* Spp.—A Capsid bug, tentatively identified as *Ragmus importunitas*, was found to occur in injurious numbers on *Crotalaria anagyroides* in Nilgiri-Wynaad and to stunt severely the growth of plants. A trial made on the Station with a DDT spray applied at the rate of 1 lb. of 50% wettable DDT powder in 20 gallons of water resulted in an almost complete kill of the bugs. New growth on the plants came away free from any sign of bug damage.

Flea beetles belonging to more than one species attack *Crotalaria* spp. wherever these are grown. The damage often takes a serious form necessitating the adoption of a control measure. Spraying with a 0.25% solution of DDT, dusting with a 50% DDT dust, or dusting with Gammexane D. 025 should help keep down the pest.

Crotalaria spp. are also often subject to attacks of a caterpillar, *Argina* spp., but the attacks do not normally warrant the use of insecticides.

Other minor pests about which enquiries were received during the year included Red Borer of coffee (*Zeuzera coffeae*), Red Slug (*Heterusia virescens*) and cutworm on tea, bark-eating borer (*Indarbela quadrinotata*) on *Albizzia* and Termites on Red Gum.

Acknowledgments.—The co-operation and ready assistance given by Managers of neighbouring estates are gratefully acknowledged. It is also a great pleasure to record appreciation of the help and hospitality received from Managers of estates visited during the year.

S. ANANDA RAU,
Asst. Scientific Officer & Entomologist.

REPORT OF THE SOIL CHEMIST (1951-52)

ADVISORY

The following samples were analysed and reported on in connection with advisory work:

Soils	..	..	..	..	133
Composts	..	..	..	..	2
Manures & Manure Mixtures	..	..	..	..	28
Sulphur, Copper Sulphate and Caustic Soda for purity..	..	..	..	..	1 each
DDT & DDT-China clay mixtures	..	..	..	..	12
Tung seed for oil content and manurial value of cake	..	..	..	..	2

Besides the above, numerous enquiries relating to various aspects of manuring of tea such as the use of alternative nitrogenous manures in place of sulphate of ammonia in view of the short supply of the latter, the manuring of young tea, the use of flour phosphate, the time and method of application of manures, and the making and storage of farm yard manure, were attended to.

Some of the manure mixture samples analysed fell short of guaranteed analysis. This is attributable in many cases to faulty sampling methods and in this connection attention of Managers is invited to the article on "Methods of Sampling Soils and Manures for Analysis" which appeared in the *Planters' Chronicle* dated 1st April 1951. The instructions given in this article should be strictly adhered to and all the information called for should be supplied together with the samples.

The majority of the soil samples analysed were from prospective nursery sites for tea and coffee. The others were from mature tea areas wherein the growth of tea was poor and from nurseries in which the seedlings were making unsatisfactory progress. In some instances the cause of the latter could be traced to unfavourable soil reaction. To cite two cases, alkalinity of the soils, with pH values of 7.47, 7.08 and 7.80, was responsible for the stunted growth of tea seedlings in one nursery and in another, damage was caused to the roots which extended beyond the basket and penetrated into an old line site soil below, which had a pH of 8.06.

The question of the economics of the manuring of tea growing in very rich soils was examined during a visit to a high elevation estate on the Nilgiris. In addition to examination of the yield figures and manuring programme, fourteen soil samples were taken from different fields for analysis. Complete chemical and physical analysis could not be undertaken immediately and hence determinations of loss on ignition, nitrogen and reaction were made. The percentage loss on ignition varied from 20.7 in sub-soils to 34.3 in top soils, the percentage nitrogen varied from 0.249 in sub-soils to 0.934 in top soils and the pH from 4.33 to 5.13. These figures show that the soils are extremely rich in organic matter and nitrogen and highly acid in reaction. Examination of the yield figures from several fields taken in conjunction with the quantity of nitrogen applied for the past ten years did not generally reveal any marked increase due to manuring and even when 54 lbs. and 92 lbs. of nitrogen were applied in two consecutive years, the increase in yield was not proportional to the doses applied. With the high cost of purchased fertilisers, transport and application, it is very doubtful whether manuring would be profitable in such rich soils. The estate is subject to high monsoon winds and frost. The limiting factor for satisfactory growth appears

to be the low temperature prevailing for most part of the year. It is proposed to take records of soil temperatures during the coming year and the soils are also to be analysed for carbon-nitrogen ratio and exchangeable bases.

COPPER CONTENT IN TEA

A large number of determinations of copper content of tea were made during the year. After wet digestion of the sample, the copper was extracted with Sodium-diethyl-dithiocarbamate and estimated colorimetrically using a Lumetron photo-electric colorimeter. The analytical work undertaken may be divided into the following sections: (1) Copper content of South Indian teas, (2) Copper content of teas dusted with copper fungicides, received from estates, (3) Copper content of sprayed tea in the Pruning and Protection trial on the Station, (4) A pilot trial to test the copper in tea, plucked daily after spraying and dusting, and (5) A trial to test the separation of copper in dusts formulated with different fillers.

(1) **Copper Content of South Indian Tea.**—Through the kind co-operation of Managers of estates, four weekly samples of green tea passed through the drier were obtained for analysis. The following are the results, which represent the average of the four samples. In addition, leaf from the different jats of bushes on the Station were also analysed for copper.

<i>District</i>	<i>Jat</i>	<i>Copper in parts per million.</i>		
Peermade	Assam ..	..	..	23.4
High Range	Assam ..	..	..	23.9
"	China hybrid..	..	..	34.9
Nilgiri-Wynaad	Assam ..	..	..	23.9
Nilgiris	China ..	..	..	34.2
"	Assam ..	..	..	18.2
"	China hybrid ..	..	..	18.2
"	Red Tea ..	..	..	22.3
Nilgiri-Wynaad	Dark-leaved Manipuri ..	..	..	22.8
" "	Light-leaved Manipuri ..	..	..	31.8
" "	Low jat hybrid ..	..	..	27.4
" "	High jat hybrid ..	..	..	25.1
" "	Blister Blight resistant clone ..	..	..	38.7
" "	Blister Blight resistant mother bush ..	..	..	31.9

From the above figures it would appear that the natural copper content of China and hybrid teas is normally greater than that of the Assam varieties.

(2) **Copper Content of Teas Dusted with Copper Fungicides.**—Made tea samples were received from estates which were adopting regular dusting with copper fungicides throughout the Blister Blight season, for a check on the copper content of the made teas. The following figures were obtained on analysis of such teas :—

Estate A

Made tea after dusting with 2% Cuprosana @ 10 lbs. per acre :

	<i>Copper in parts per million.</i>		
After 4 rounds	..	..	29.6
" 11 "	..	..	59.2
" 18 "	..	..	42.1
" 19 "	..	..	47.8
" 19 "	..	..	51.2
Undusted tea	..	..	22.8

Estate B

Dusted with 2% Cuprosana @ 10-day intervals :

			<i>Copper in parts per million.</i>
After 14 rounds—Sample 1	..	..	36.4
" " " — " 2	..	..	31.9
Undusted tea	..	..	27.3

Estate CDusted shortly before plucking with 2% Cuprosana @ 10, 12 lbs.
per acre :

B.O.P.	..	..	..	56.9
B.P.	..	..	..	43.3
B.O.P. Fannings	..	..	..	56.9

Undusted :

B.O.P.	..	..	..	38.7
B.P.	..	..	..	36.4
B.O.P. Fannings	..	..	..	41.0

Estate DAccidentally dusted with 2% Cuprosana @ 8 lbs. per acre 2 days
before plucking :

Big Bulk	..	..	..	27.3
Fine Bulk	..	..	..	59.2

The above figures indicate that the copper content of dusted teas remains well within the tolerance limit of 150 p.p.m.

(3) Copper in Sprayed Tea.—At the time of the first tipping of the Pruning and Protection trial at the Experiment Station and also once thereafter, samples of flush were taken at random from the leaf plucked from each treated block and analysed for copper. The treatment details and the copper contents are tabulated below.

Treatment	Copper in p.p.m.	
	<i>At Tipping after 7 rounds</i>	<i>After 14 rounds.</i>
Pruned and untreated	29.5	27.3
Perenox 2 oz. in 10 galls. low volume 17½ galls./acre	70.5	36.4
Perenox 4 oz. in 10 galls. low volume 17½ galls./acre	90.1	68.3
Cuprosana 2% at 12 lbs./acre	43.2	100.1
Cuprosana 6% at 8-10 lbs./acre	66.0	41.0
Perelan 4% at 14 lbs./acre	88.7	41.0

Owing to the accumulation of the fungicides on the unplucked tea, the copper content was higher at tipping time and when regular weekly plucking started the figures obtained were lower, except in the case of 2% Cuprosana. Probably the higher figure in 2% Cuprosana is due to sampling error. These figures show definitely that with weekly rounds of spraying or dusting at the usually recommended strengths, there need be no fear that the copper content will exceed the tolerance limit of 150 p.p.m. In fact, under the conditions of this experiment where considerable attention was given to individual bushes both in spraying and dusting, the copper content did not exceed 100 p.p.m. indicating that under field conditions the figures for copper are likely to be considerably less.

(4) **Copper Content of Tea Plucked Daily After Treatment.**—In this trial the tea was plucked daily for six days from the day following spraying or dusting and analysed for copper. Five rows of tea were selected, one for each treatment, each treated row being separated from the next by two guard rows. The tea was plucked on 19th October 1951, fungicides applied on 22nd October 1951 and leaf was taken for analysis from each row on each of the six succeeding days. The results are given in the following table. The sprays were applied at low volume rates and the dusts by "Acme" hand duster at about 10 lbs./acre.

TREATMENT	COPPER CONTENT IN P.P.M.						
	Days after treatment.						Remarks
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	
1. Untreated ..	27.3	27.3	27.3	31.9	31.9	31.9	6 cents rain on first day and no rain afterwards. Heavy morning mists.
2. Perenox— 2 oz. in 10 galls. ..	104.7	86.5	136.5	72.8	54.6	54.6	
3. Perenox— 4 oz. in 10 galls. ..	232.0	186.6	168.4	118.3	100.1	100.1	
4. Cuprosana 2% ..	446.0	464.1	1137.5	423.2	200.2	109.2	
5. Perelan 4% ..	222.9	177.5	195.7	163.8	68.3	41.0	

The general tendency for the copper content to decrease as the interval after application increases is evident from the figures. Although no generalisation is possible from a single experiment like this, it seems that there is a danger of exceeding the tolerance limit, its leaf is manufactured within a short interval after spraying or dusting, in a period free from rain. The higher copper content in the leaf dusted with 2% Cuprosana than in that dusted with 4% Perelan is probably due to the much more free-flowing nature of the former dust.

Part of the detail given in the above paragraphs has already appeared in the article on "The Problem of Copper Contamination in Tea" by Peter de Jong (*Planters' Chronicle*, 1st December 1951, pp. 619-623). It is worthwhile reproducing here the concluding paragraph of the article.

"The analyses carried out so far this season lead us to believe that as long as spraying or dusting is undertaken using strengths of fungicides and rates of application recommended by the various Research Institutes and Scientific Departments and as long as the field programme is so organised that fungicidal applications follow as soon after plucking as possible, so that the maximum possible interval elapses before the next round of plucking, there is little danger of copper residues in the manufactured teas exceeding the prescribed limits of tolerance. An additional safety factor is that in South India the practice at present is to treat only the younger fields in the cycle so that 50% or more of the tea is untreated and when this is bulked with treated teas the final quantity of residual copper is materially reduced."

(5) **Copper Dust with Different Fillers.**—Samples of Perelan 4% dust formulated with four different fillers, namely, talc, gypsum, dolomite and China clay were received for trial during the season 1952-53. As a first step it was decided to test the extent of separation in each of these dusts. For this purpose

each dust was put through a rotary duster and samples of dust falling at distances of 4, 8, 12 and 16 feet from the machine on glass plates at a height of $3\frac{1}{2}$ feet and also on the ground were collected for copper analysis. This trial was only of a preliminary nature and the figures for copper indicated that there was distinct separation in the case of dust with China clay as the filler, copper being highest nearest to the machine both on the glass plate and on the ground and decreasing further on. There was also separation in the dust with dolomite as filler but not to the same extent as in China clay. There was practically no separation in the case of dusts with gypsum and talc as fillers. These results will be confirmed, and a further series of investigations carried out, during the next season.

FIELD EXPERIMENTS

The yield data for the existing field experiments and details of the new experiments started during the year are tabulated below.

PLANT FOOD REQUIREMENTS

A. 27 Plot ($3 \times 3 \times 3$) Factorial Experiment

Tea Experiment Station.—The following are the yield figures for the second year of the fourth cycle.

TABLE 1

<i>Nitrogen</i>	0 lbs.	40 lbs.	80 lbs.	
Yield	1,366.5 lbs.	1,443.6 lbs.	2,045.1 lbs.	made tea/acre.
<i>Phos. Acid</i>	0 lbs.	20 lbs.	40 lbs.	
Yield	1,639.5 lbs.	1,564.5 lbs.]	1,651.2 lbs.	" " "
<i>Potash</i>	0 lbs.	20 lbs.	40 lbs.	
Yield	1,055.4 lbs.	1,741.8 lbs.	2,058.0 lbs.	" " "

Differences required for significance :

P : 0.05 = 487.8 lbs. made tea.

P : 0.01 = 738.9 " " "

Application of 40 lbs. nitrogen has once again failed significantly to increase the yield. 80 lbs. application has continued to give a significant increase.

20 lbs. and 40 lbs. applications of potash have both resulted in increased yields, the difference between 0 lbs. and 20 lbs. being significant at 5% level and that between 0 lbs. and 40 lbs. being significant at 1% level, though the difference between 20 and 40 lbs. is short of significance.

The experiments on Anai Mudi and Korakundah estates have been discontinued.

B. 25 plot (5×5 Randomised Block) Experiment

High Range (Kanniamallay, Munaar, Letchmi and Nullatanni)

TABLE 2

	No Manure	Nitrogen,	Nitrogen & Phos. acid	Nitrogen & Potash	Nitrogen Phos. acid & Potash
Kanniamallay	1,234.4	1,403.5	1,426.1	1,416.9	1,393.2 lbs. made tea/acre
Munaar	840.2	969.8	977.4	1,037.3	1,003.3 " " "
Letchmi	214.9	184.1	184.2	235.4	295.4 " " "
Nullatanni	214.9	392.6	428.2	304.0	487.1 " " "

Critical difference: P: 0.05

Kanniamallay : 123.1 lbs. made tea.

Munaar : 123.1 " " "

Nullatanni : 60.3 " " "

On Kanniamallay and Munaar estates all treatments show a significant increase over the yields of the control plots, though there is no significant difference between any of the individual treatments themselves. It would appear that in these cases it is the nitrogen which is responsible for the recorded increases and the presence or absence of phosphates and potash is immaterial.

On Letchmi estate, the plots were out of plucking for five months during the year. In this trial, the plots are extremely variable and in the period prior to the commencement of the experiment the control plots consistently gave much higher yields. In the case of this experiment, analysis by co-variance indicates that there is a probable yield response to potash.

On Nullatanni estate, yield figures are available for 11 months only. Here, too, plot variability is very high and some plots were out of plucking or gave very low yields during some months because of damage by frost.

C. 24 Plot (3 × 8 Randomised Block) Experiment.

Nilgiris : Korakundah.—In place of an earlier experiment which had been laid out in an area with heavy *Acacia* shade, a new trial was started on an area with light *Grevillea* shade only. The manures were applied during May 1951. The following are the yield figures to the end of March 1952 :—

TABLE 3

<i>Nitrogen</i>	..	0 lbs.	40 lbs.	80 lbs.
<i>Yield</i>	..	607.6	688.4	680.8 lbs. made tea/acre.

The differences are not significant. A census of the number of bushes in the plots is being taken in order to use it to correct the yields for plant population.

D. 25 Plot (5 × 5 Randomised Block) Experiment.

Nilgiri-Wynaad : Rockwood.—Assistance was given to this estate in laying out and in the conduct of a field trial designed to test the effect of nitrogen alone and in combination with phosphoric acid and potash on debilitated tea. The bushes were pruned during the last week of October 1950 and a record of the weight of green prunings was taken at that time. The manures were applied during the first week of May 1951. The following are the yield data up to 31st March 1952 :—

TABLE 4

No Manure	Nitrogen	Nitrogen & Phos. acid	Nitrogen & Potash	Nitrogen, Phos. acid & Potash.
	50 lbs./ acre	50/25 lbs./ acre	50/25 lbs./ acre	50/25/25 lbs./ acre
416.3	414.7	425.5	390.4	424.3 lbs. made tea/acre.

The figures in Table 4 are for the first 11 months of the trial and there are no observable differences between the gross yields of the various treatments. Even where correction is made on the basis of bush populations, to compensate for an initial unevenness in bush numbers in the individual plots, examination of the yields shows no difference which could be considered truly significant. This trial, however, will have to run for at least two pruning cycles before any valid conclusions can be arrived at.

E. Soil Amendment Trials.—The purpose of these trials, which are conducted in co-operation with Parry & Company Ltd., Madras, is to ascertain the effects of heavy dressings of phosphoric acid and potash, applied at regular intervals as a soil conditioner, on the response of tea to normal manurial applications. The heavy clay latosols of the Nilgiri-Wynaad are abundant in free aluminium and iron and it is postulated that by the application of large amounts of phosphatic material a proportion of these freely available sesquioxides will be saturated, thereby reducing the degree of soil fixation by the iron and aluminium oxides of phosphates and potash applied in normal fertiliser mixtures, and thereby increasing their availability to the tea.

This trial is duplicated on Daverashola and Mayfield estates, adjacent to the Tea Experiment Station, and a similar trial has been started on Craigmore estate in the Nilgiris, in co-operation with the Agents and Management of the estate, and Indo-Agri Limited, Madras. In all these trials, the treatments are : (1) No manure, (2) NPK mixture, in accordance with standard estate practice, (3) Soil amendment, consisting of 700 lbs. rock phosphate and 100 lbs. 60% Muriate of Potash per acre, applied once every three years, and (4) Standard NPK mixture *plus* Soil Amendment. In the trial on Daverashola Estate, an additional treatment, namely, nitrogen alone at the rate of 60 lbs. per acre, has been included.

These trials are expected to run for a minimum of three pruning cycles and valid results cannot be expected before several years have elapsed.

F. Manuring of Young Tea.—To compare the efficiency of different manurial treatments on the growth of young tea and its wood development, a trial was started on an estate in Nilgiri-Wynaad, an estate in the Nilgiris and on one in Central Travancore. There are three treatments, namely, (1) No manure, (2) Sterameal, a concentrated balanced organic fertiliser analysing 7% N, 10% P and 5% K, and (3) Sterameal, with added P and K to make the ratio of N : P : K as 1 : 2 : 3, each treatment being replicated six times. Before application of the manures, records of girth of stem, height of plant and number of side branches are being taken. The manures are to be applied in May 1952 and at definite intervals thereafter.

Acknowledgments.—Grateful acknowledgments are due to Managers of estates visited for all the help received. At the same time, I should like to acknowledge the assistance I have received from Mr. V. Raman in the conduct of analyses and in statistical work.

V. JAYARAMAN,
Soil Chemist.

REPORT OF THE BOTANIST

(1951-52)

ADVISORY

Technical correspondence dealt with by this section pertained to various botanical and mycological aspects of tea, coffee, rubber, ginger, shade and green-manure plants, and comprised 126 enquiries most of them accompanied by specimens. This aspect of work together with experiments on Blister Blight control occupied the greater part of the time at our disposal.

TEA

LEAF DISEASES

Leaf diseases caused by various fungi, such as *Glomerella cingulata* (Brown Blight), *Pestalotia theae* (Grey Blight), *Phoma theicola*, *Asterina camelliae* and *Corticium invisum* (Black Rot), were occasionally reported. Blister Blight (*Exobasidium vexans*) continued to be the only disease of major importance, the control of which was actively investigated during the year. Details of the various experiments on the control of this disease are presented in Part II of the Chief Scientific Officer's Report. Mention, however, may be made here of a pilot trial conducted with an oil-based copper fungicide developed by Clean Crops Limited. The fungicide was sprayed on to the bushes by means of a hand atomiser, the dilution used being one part of fungicide in three parts of water. The fungicide had no phytotoxic effect and it appeared to give a satisfactory control of the disease.

STEM DISEASES

Die-back of shoots and branch cankers due to attacks by fungal pathogens (*Leptothyrium theae*, *Macrophoma theicola* and *Nectria* sp.) were recorded from several estates. *Macrophoma theicola* was confined mainly to certain low elevation estates. Its perithecial stage, *Physalospora neglecta*, was observed on one of the specimens received for examination. Red Rust caused by a parasitic alga, *Cephaleuros parasiticus*, was another report of interest received from Travancore.

“Red Rust”.—This algal disease is not new to South India, it having been recorded from Travancore as early as 1936. It was, however, not considered serious at that time. In July 1951, our attention was directed to the widespread occurrence of the alga on an estate in Central Travancore and a visit was made to that district in October 1951 to make a preliminary study of the incidence of the disease. Although the organism was seen on almost every field on all the estates visited, both on apparently healthy and weak tea, it did not appear to have caused any great damage. However, in certain fields of rested and young tea, the situation was different. In these cases definite damage in the form of die-back of shoots and poor development of the frame was noticeable in some of the affected plants.

It is in the new clearings and in young replanted tea that the damage could become serious, should conditions not favour the vigorous growth of the plants. It, therefore, seems desirable initially to concentrate on eradicating the disease from the young plants. Any measure undertaken to aid quick and vigorous growth of the young plants can be expected to control Red Rust to a great extent, for vigorously growing plants appear to withstand the attack and throw off the disease. In addition, protection against new infections can be had by spraying the plants with a copper-based fungicide, especially at the time when the alga is “fruiting” profusely.



PLATE II—TEA ROOT ATTACKED BY FUNGUS OF GENUS 'CYLANDROCLADIUM'

“Red Rust” is generally regarded as “a disease of weak bushes”, but with potentialities for great damage should the vitality of the tea in general be impaired for any reason. With *Helopeltis* attack on the one hand, and Blister Blight and recurring droughts adding to the debility of the bushes on the other, the Red Rust situation in Central Travancore requires to be carefully watched. In this connection, the life-history and the factors conducive to the active development of the alga under South Indian conditions are being studied.

ROOT DISEASES

The four common primary root diseases constantly reported from the estates were Red Root Disease (*Poria hypolateritia*), Black Root Rot (*Rosellinia arcuata*), Charcoal Stump Rot (*Ustilina zonata*) and Brown Root Diseases (*Fomes noxius*). Large patches of diseased tea were observed during the course of visits to some estates in Mysore, Nilgiri-Wynaad and Central Travancore. *Fomes noxius* and *Ustilina zonata* were invariably the causal organisms concerned in those areas.

These diseases and their control are not new to planters, but it is once again emphasised that early action is essential to keep the diseases within bounds. Elimination of infectious material and checking the spread of the fungus in the soil are the only reliable methods yet known for controlling the root-infecting fungi of plantation crops.

Effect of Soil Fumigants on Soil Fungi.—Laboratory trials are being made to determine the role, if any, of a few soil fumigants on the growth and survival of root-infecting fungi.

Cylindrocladium Disease.—During a visit to Central Travancore in October 1951, a small patch of unthrifty tea was observed on one of the estates. The bushes appeared “thin” with weak development of the branches and only a crown of unhealthy foliage. Examination of the aerial parts did not reveal any sign of insect damage or fungal attack. The roots, however, showed certain characteristic symptoms, namely, the entire absence of feeding roots and the presence of circular or slightly elongated and raised patches all over the bark of the tap and lateral roots, and also extending to the collar—a feature not associated with any of the known root diseases of tea. The lesions varied in size from minute spots to small patches measuring 2-15 mm. across. (Plate II). The discolouration of the bark in the affected regions extended to a few cells only in the case of the small spots, while in the larger lesions the entire depth of the bark was affected and the wood too was occasionally seen to be discoloured just below the necrotic area on the bark. In some cases the affected bark had fallen off leaving a shallow scar or depression on the root surface. A fungus was isolated from the affected regions and was identified as a species of *Cylindrocladium*, differing from the various described species in certain morphological characters.

The diseased patch is situated on the bank of a river, the water table apparently being fairly high for most part of the year. Whether this feature, not usually met with in South India, favours the activities of the fungus has yet to be determined. The soil is a sandy loam, acidic in reaction (the pH values being 6.12 and 4.96 for the top- and sub-soils) and, in general, suitable for the normal growth of tea. This is the first record of the fungus on tea in South India and it is not yet established whether it is a primary pathogen or a weak parasite invading the roots of bushes debilitated by other causes. The fungus and its behaviour are being studied further.

SEEDLING DISEASES

"Bitten off" of seedlings due to unfavourable soil conditions (alkaline soil) and scorching of the leaves owing to sudden exposure of young plants to direct sunlight were the common troubles experienced in nurseries.

Gall-like swellings on leaves.—A few nursery plants received from an estate showed peculiar, white, gall-like swellings on the leaves. The parts involved were the mid-rib and portions of the lamina on either side of the mid-rib, or the extreme tip of the young leaf. Microscopic examination did not reveal the presence of any micro-organism, nor could any bacterium or fungus be isolated on artificial culture media. There was no differentiation into palisade and spongy parenchyma tissues at the affected regions. The cells were all rounded, thin-walled, and suggestive of hyperplastic development. The interesting features associated with such cells were the absence of chloroplasts and the accumulation of starch grains in abundance.

All methods of inoculation failed to induce similar symptoms on young leaves of healthy seedlings. Even in the case of the affected plants, new leaves produced after a time were free from such swellings and the growth of the plants thereafter was normal. Whether the abnormal swellings were due to any physiological disturbance or a virus reaction remains yet a moot question.

MISCELLANEOUS

WEED-KILLERS

Weed control, especially the eradication of grasses in tea fields, has become an important problem in certain tea areas. A preliminary trial was undertaken to find out whether any of the modern weed-killers would be efficient in checking the growth of established perennial grasses without injuring the tea plants. The following formulations were tried on a small scale in a first year tea field at the rates mentioned and only one application was made :—

- | | | |
|---|----|--|
| (i) Sodium Trichloracetate (Sodium TCA 90%) | .. | 50 lb. in 100 galls.
of water per acre. |
| (ii) Pentachlorophenol Liquid Concentrate | .. | 2 lb. " " |
| (iii) Isopropylphenylcarbamate (IPC) | .. | 100 lb. per acre as
dust. |
| (iv) Aromex (mineral oil) | .. | 30 galls. per acre. |

Aromex had an immediate effect on all weeds, it having scorched them within a few hours of application. Grass, however, established itself once again within a few weeks. Pentachlorophenol and IPC had no effect on any of the weeds at the concentrations and rates at which they were tried. TCA was the only herbicide which showed promise of keeping grass under control and it deserves a further investigation. None of the treatments appeared to have had any ill-effect on the tea bushes. However, until more is known about the effects of these potent herbicides on the growth of the tea bush, it is not considered safe to employ any of them indiscriminately in tea fields in bearing or in new clearings. This aspect is receiving further consideration.

ACTUMUS

A sample of imported, activated organic material called Actumus was tested for its effect on the growth of plants. A small-scale pot trial was started with *Crotalaria Grahamiana* as the test plant, local garden soil being the growing

medium. One series of pots received an application of Actumus at the rate of 20 lb. per acre and another was kept as an untreated control, an equal number of seeds being sown in each pot. Growth measurements made at the end of six weeks did not reveal any beneficial effect of the treatment.

GREEN-MANURE PLANTS

Many *Crotalaria* species and other green-manure plants were received for identification. These were identified as far as possible. Material is being collected in order to prepare a descriptive account of the common green-manure plants grown on South Indian estates.

GREVILLEA

Diseased nursery plants of *Grevillea robusta* were received for examination from an estate on the Nilgiris, the trouble experienced being reported as defoliation and die-back of the shoots. The affected leaves showed numerous black spots caused by a fungus, *Amphichaeta grevilleae*. Inoculation tests made on healthy seedlings showed that the fungus was pathogenic and laboratory tests indicated that spraying the plants with 1% Bordeaux mixture or 0.25% Perenox would be sufficient to check the spread of the fungus. The fungus was described by Lods in Ceylon in 1948 (Tea Research Institute of Ceylon, *Bulletin No. 30*, Annual Report, 1948) and this is the first record of the occurrence of this organism in South India.

ACACIA

Wilting and death of young plants of *Acacia elata* were reported from an estate on the High Range, Travancore. The causal organism was identified as a fungus, *Nectria lucida*.

COFFEE, RUBBER AND GINGER

The Brown Eye Spot disease of robusta coffee caused by *Cercospora coffeicola*, leaf spotting and defoliation of hevea rubber seedlings brought about by severe infections of *Phyllosticta heveae*, and rhizome rot of ginger due to a species of *Pythium* were some of the enquiries of importance dealt with on these crops.

ACKNOWLEDGMENTS

Assistance derived from various sources is greatly appreciated and gratefully acknowledged.

K. S. VENKATARAMANI,
Botanist.

APPENDIX I

Monthly Statement of Crop in lbs. green leaf

(Tea Experiment Station, Devarshola)

	1949-50	1950-51	1951-52
April ..	3,544	2,016	2,681
May ..	6,098	1,678	11,323
June ..	5,005	2,238	6,482
July ..	7,291	9,994	7,567
August ..	5,887	3,843	6,222
September ..	4,546	4,611	7,442
October ..	5,566	4,635	8,782
November ..	4,393	4,867	5,237
December ..	2,113	2,875	2,399
January ..	1,434	2,846	2,593
February ..	1,615	1,839	2,495
March ..	2,312	1,882	3,450
Total ..	49,804	43,324	66,673

APPENDIX II

List of Publications of the Scientific Department
for the year 1951-1952

- 1-4-1951. "Methods of Sampling Soils & Manures for Analysis" by V. Jayaraman, Soil Chemist (*Planters' Chronicle*, Vol. XLVI, No. 7, pp. 180-181).
- 15-4-1951 "How to Send Plant Specimens for Examination" by K. S. Venkataramani, Botanist (*Planters' Chronicle*, Vol. XLVI, No. 8, pp. 213-214).
- 15-5-1951 "A Preliminary Report on the Trial of Certain Fungicides for the Control of Blister Blight" by K. S. Venkataramani & Others (*Planters' Chronicle*, Vol. XLVI, No. 10, pp. 270-272).
- 15-6-1951 "The Removal of Mosses and Lichens from Pruned Tea" by Peter de Jong (*Planters' Chronicle*, Vol. XLVI, No. 12, pp. 312-314).
- 1-7-1951 "Tea in Japan—A Review" by Peter de Jong (*Planters' Chronicle*, Vol. XLVI, No. 13, pp. 344-347).
- 15-11-1951 "Hydroponics—The Bengal System (A Review)" by K. S. Venkataramani (*Planters' Chronicle*, Vol. XLVI, No. 22, pp. 607-609).
- 1-12-1951 "The Problem of Copper Contamination in Tea" by Peter de Jong, (*Planters' Chronicle*, Vol. XLVI, No. 23, pp. 619-623).

- 15-12-1951 "Low Volume Spraying" by Peter de Jong (*Planters' Chronicle*, Vol. XLVI, No. 24, pp. 648-650 & Vol. XLVII, No. 3, p. 60).
 &
 1-2-1952 "Copper Fungicides in the Control of Blister Blight of Tea in South India" by Peter de Jong (*Plant Protection Overseas Review*, December 1951).
 "Some Recent Changes in Tea Culture in South India" by Peter de Jong (*Tea Trade & Industry*, January 1952).

APPENDIX III

Touring by Officers of the Scientific Department

April 1951	Chief Scientific Officer— Asst. Scientific Officer & Botanist—	Anamallais P. A. Mysore P.A.
May 1951	Chief Scientific Officer & Soil Chemist—	Korakundah Estate.
June 1951	Asst. Scientific Officer—	Mount Stuart Estate, Anamallais.
September 1951	Chief Scientific Officer & Asst. Scientific Officer—	Mount Stuart Estate, Anamallais.
October 1951	Chief Scientific Officer— Assistant Scientific Officer & Botanist—	High Range. Central Travancore P.A.
November 1951	Asst. Scientific Officer & Soil Chemist—	Food Technological Institute, Mysore.
January 1952	Chief Scientific Officer—	North-East India ; I.T.A. Scientific Department, Tocklai, Doom Dooma & Darjeeling.
February 1952	Chief Scientific Officer— Asst. Scientific Officer—	High Wavys, Central Travancore P.A., Mundakayam P.A. & South Travancore P.A. Wynaad P.A. & Coorg P.A.

In addition to the above tours, a number of visits were made to estates in the Nilgiris P.A. and Nilgiri-Wynaad P.A. During the visits to the various districts, the Chief Scientific Officer and the Asst. Scientific Officer had the opportunity of addressing meetings of the various District Planters' Associations on matters of scientific interest.

Members of the Staff of the Tea Experiment Station attended meetings of the Nilgiri-Wynaad P.A., the Coffee Planters & Research Workers Conference at Chikmagalur, and the U.P.A.S.I. Annual General Meetings.

